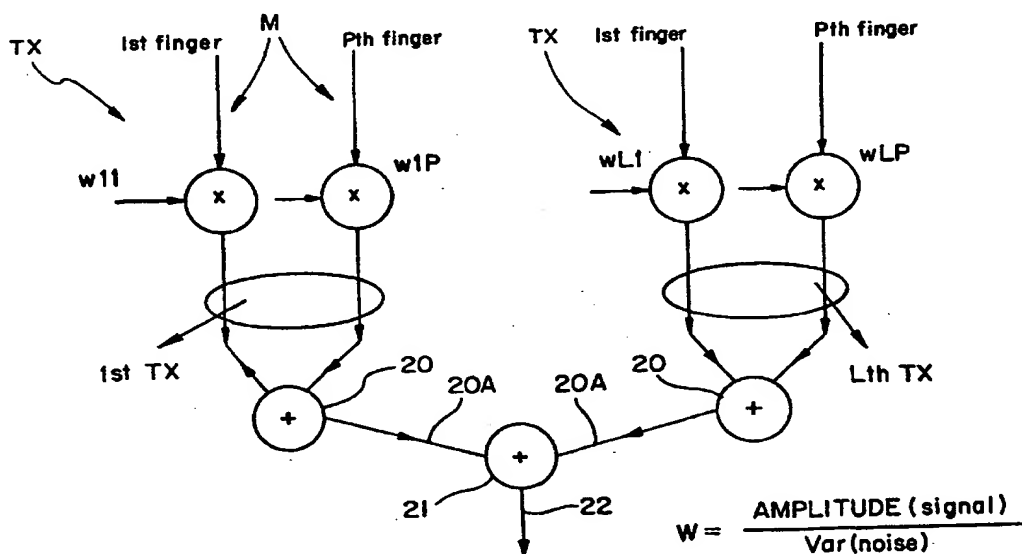


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(54) Title: RETRANSMISSION PACKET CAPTURE SYSTEM WITHIN A WIRELESS MULTISERVICE COMMUNICATIONS ENVIRONMENT



## (57) Abstract

A "hybrid" ARQ system within a multiple access wireless communications environment is provided for recombining ARQ retransmission signals with information obtained from corresponding previously failed transmissions of the same signal which had been sent and received within the air interface. Forward Error Correction (FEC) is implemented within an ARQ environment by using whatever acquired information has been previously obtained from RAKE processed transmitted and retransmitted signals and trying to correct the information by combining the signals and without retransmission.

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1           **RETRANSMISSION PACKET CAPTURE SYSTEM WITHIN A**  
2           **WIRELESS MULTISERVICE COMMUNICATIONS ENVIRONMENT**

3  
4           **FIELD OF THE INVENTION**

5           The present invention relates generally to wireless communication  
6 systems, and more particularly, to a system and method for correctly  
7 transmitting and re-transmitting data packets in a wireless multi-media  
8 communications environment.

9  
10          **BACKGROUND OF THE INVENTION**

11          Various organizations worldwide are currently developing  
12 standards for the specification of the next generation of mobile  
13 telecommunications systems. Services offered by current wireless mobile  
14 systems are telephony and voice services supported by narrowband  
15 digital networks. There will be a demand for higher bandwidth services as  
16 more comprehensive data and information is transmitted. This  
17 comprehensive data will require mobile systems to interface with  
18 hardwired broadband networks using asynchronous transfer mode (ATM)  
19 transmission (defined below). Thus, today's wireless interface must carry  
20 narrowband services effectively while providing the flexibility to carry  
21 higher bandwidth services as the demand increases.

- 2 -

1           However, the harmonization of multiple communication services  
2   with different characteristics results in distinguishable spectrum and  
3   transmission needs. Representative services used on wireless  
4   communication networks include telephony, videotelephony, and high-  
5   speed data transmission. These services have varying and  
6   distinguishable needs which include being in high demand, being delay  
7   critical, requiring high bandwidth, and/or being intolerant of errors. These  
8   different services also have different encoding requirements, different  
9   error transmission requirements and different delay requirements. The  
10   trade-offs of these different requirements of the different services used on  
11   the network, when they are integrated into a single cohesive whole, lead  
12   to limitations in the ability of the network to transmit a large amount of  
13   information quickly, correctly and simultaneously.

14           The radio access technique most often utilized for these diverse  
15   requirements is known as code division multiple access (CDMA). CDMA  
16   and ATM characteristics, separately and in combination, offer significant  
17   advantages in wireless communication environments where a wide range  
18   of services must be carried. Both CDMA and ATM allow a transmission  
19   link to support a number of simultaneous connections which can be used  
20   on demand to simplify routing and reduce traffic congestion and  
21   overhead.

22           CDMA allows many users to share the same radio frequency  
23   spectrum simultaneously through the use of spread spectrum

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1 transmission. Each individual connection across the radio interface is  
2 distinguished by a CDMA code allocated to that connection. Since there  
3 is a relatively large number of codes, they can be allocated to new  
4 connections as the connections are set up or when a new mobile station  
5 affiliates to a base station servicing multiple users. User data is  
6 transmitted over the air interface with an associated CDMA code and  
7 without the need for additional channel assignments. Thus, the CDMA  
8 code identifies the signal and represents a "virtual" channel connection for  
9 the air interface.

10 A reality of wireless communications is that data is communicated  
11 at essentially random times. Additional data may be added to the system  
12 and transmitted at any time. These random transmissions may, in the  
13 aggregate, force the system capacity to be exceeded and cause  
14 interference between users. These dynamically changing traffic  
15 characteristics may increase above system limitations and cause  
16 unacceptably excessive error rates.

17 ATM subdivides data for transmission into small fixed size packets  
18 called ATM cells which contain groups of information. Each ATM cell  
19 includes a data field and a control field which includes an address. The  
20 address within the control field can also be considered a virtual channel  
21 connection within a fixed network since multiple users are each identified  
22 by a separate address allocation. ATM is unlike traditional transmission

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1 systems in that it is asynchronous, and only uses network capacity when  
2 there is data to be transmitted.

3 Another communications transfer mode known in the art is time  
4 division multiple access (TDMA). TDMA is similar to ATM, with the  
5 exception that TDMA is not asynchronous. Each TDMA transmitter sends  
6 a "cell" of information each time it is "polled."

7 In mobile digital information transmission techniques, specifically  
8 CDMA, ATM and TDMA, data information is considered to be "bursty" in  
9 that significant amounts of data are reduced to "packets" and transmitted  
10 in "bursts." Burst mode transmission results in information packages  
11 being sent and packetization delays. The process of filling ATM cells with  
12 speech also involves packetization delays.

13 The inherent nature of radio communications, in terms of  
14 transmitter power constraints and limited spectrum availability, also  
15 restricts the maximum amount of information which is possible to be  
16 transmitted over an air interface. Thus, within an air interface, broadband  
17 communication services must be regarded as being similar to narrowband  
18 services due to the mobile power constraints and the limitations of the  
19 data transfer rate on the air interface network. Additionally, radio  
20 transmission is significantly more error prone than broadband hard-wired  
21 networks. This tends to further reduce capacity due to the necessity to  
22 transmit and process error control protocols.

1           The standard known in the art which was created by the  
2   International Telecommunications Union (ITU) for the wireless multimedia  
3   communications environment is known as IMT-2000. Figure 1 shows a  
4   graphical depiction of the various subsystems of a mobile radio station in  
5   conjunction with an associated base station within a multiple access  
6   environment under the IMT-2000 standard.

7           In Figure 1, the base station 12 includes a base station control 11  
8   which controls the base station 12. The base station 12 communicates  
9   over a wireless interface 13 to a mobile station 14. The mobile station  
10   also includes a mobile station control 15. Each of the systems graphically  
11   shown in Figure 1 includes the following subsystems, an internal network  
12   16, link access control subsystems 17, medium access control  
13   subsystems 18, and the physical radio air interface transmission system  
14   19.

15           Current wireless communication of data, as used and as planned  
16   for implementation with IMT-2000, uses a system of error correction and  
17   reliability known as "Automatic Repeat Request" (ARQ). ARQ is a  
18   strategy of error correction which requests the re-transmission of a packet  
19   of data when the transmission is not completely and accurately received.

20           In ARQ, the receiver provides a signal to the corresponding data  
21   packet transmitter that the information data packet was not adequately  
22   received. Upon receipt of the ARQ signal, signifying an error in the  
23   previous transmission, the transmitter again re-transmits the data packet

- 6 -

1 to the receiver. This process is reiterated until the data packet is  
2 adequately received. The receiver is then able to receive the next data  
3 packet to be sent.

4 The ARQ process causes system delays as identical information is  
5 transmitted and retransmitted over and over again until the signal  
6 representing the data packet is deemed acceptable or is considered to  
7 have failed and the transmission of that information data packet is  
8 aborted. These retransmissions of identical information add unwanted  
9 network traffic causing system degradation and interference.

10 One system architecture utilized in wireless spread spectrum  
11 communications is known as pre-combining "rake." In this rake  
12 architecture, multiple path parameters for the received signal are derived  
13 from a downlink pilot signal and used for phase, amplitude, and time  
14 alignment of the various multiple path components which are combined  
15 prior to demodulation. Essentially, pre-combining rake recognizes that a  
16 single transmitted signal sent over a wireless communications link will  
17 have multiple components or "metrics" which must be combined by a  
18 receiver to obtain a single accumulated signal input for the Viterbi  
19 Algorithm, known in the art.

20 When the rake architecture is used within wireless communications  
21 systems, a transmission is deemed to fail when insufficient multiple path  
22 components are received and their combined power level is not above a  
23 predetermined threshold.



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1           When the transmission fails, the rake receiver must undertake an  
2 error correction system. It transmits an ARQ request. The information  
3 signal is then re-transmitted by the transmitter. This process is reiterated  
4 until the signal is deemed to be adequately received, i.e., it is above the  
5 predetermined power threshold when rake recombination is completed.

6           However, the addition of multiple transmissions of the same signal  
7 adds unwanted traffic within the transmission network. Further, the rake  
8 system has power constraints due to multiple users on the network with  
9 different power availability. One user's transmission may interfere with  
10 the power level of another user's reception.

11

12

### **OBJECTS OF THE INVENTION**

13           It therefore is an object of the present invention to provide an  
14 improved system for providing a wireless telecommunications system  
15 which will effectively carry narrowband services while providing the  
16 flexibility to carry higher bandwidth services.

17           It is a further object of the present invention to provide a wireless  
18 communications system which effectively addresses the differing wireless  
19 communications transmission and spectrum needs of multiple services  
20 (such as telephony, videotelephony, and high-speed data transmission),  
21 including being delay critical, requiring high bandwidth, and being  
22 intolerant of errors.

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1           It is yet a further object of the present invention to provide a  
2   transmission system within a multiple access wireless communications  
3   environment which reduces unnecessary and unwanted information traffic  
4   on the network, reduces interference between users, addresses  
5   dynamically changing traffic characteristics in a way which provides for  
6   gradual degradation of system quality when network traffic limitations are  
7   exceeded and thereby reduces unacceptable communications errors.

8           It is still a further object of the present invention to provide a  
9   transmission system within a multiple access wireless communications  
10   environment which minimizes the necessary number of ARQ  
11   retransmissions of identical information in order to obtain an acceptable  
12   signal and thereby reduces unwanted information traffic from the wireless  
13   network.

14

15                                   **SUMMARY OF THE INVENTION**

16           These and other objects and advantages are achieved by the  
17   present invention by implementing a "hybrid" ARQ system within a  
18   multiple access wireless communications environment. The system  
19   recombines ARQ retransmission signals with information obtained from  
20   corresponding previously failed transmissions of the same signal which  
21   had been sent and received within the air interface. The present  
22   invention is considered to be "hybrid" ARQ in that it implements Forward  
23   Error Correction (FEC) within an ARQ environment by using whatever

1     acquired information it has already obtained and trying to correct the  
2     information without further retransmission.

3             The present invention recognizes that there is a trade-off between  
4     the number of ARQ transmissions within a network to obtain a single  
5     correct signal, and the interference caused by the re-transmission of the  
6     same signal over and over again until signal is correctly received. The  
7     present invention resolves this trade-off by processing the re-transmitted  
8     signal with the processed information already obtained from previously  
9     received corresponding signals which were transmitted and failed, i.e.,  
10    they yielded an unacceptable resulting signal.

11            By combining corresponding re-transmissions, the present  
12    invention increases the likelihood that a successful transmission will be  
13    quickly achieved. The present invention recognizes that the probability of  
14    a successful transmission is geometrically increased as the number of  
15    correspondingly similar re-transmissions are combined to obtain a single  
16    correct signal. The combination of re-transmissions also allows the  
17    preferred embodiment of the present invention to minimize the number of  
18    likely re-transmissions necessary to achieve a successful signal being  
19    received, and thereby reduces the information traffic on the network. This  
20    further allows an increase in the number of users on the network without  
21    excessive degradation of the quality of transmission by the gradual  
22    increase in users.

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**BRIEF DESCRIPTION OF THE DRAWINGS**

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The features, organization, advantages and objects of this invention will be fully understood from the following detailed description and the accompanying drawings. The drawings contained herein are not considered to be accurate depictions of the embodiments of the invention, but are provided for illustrative purposes only and are to be interpreted in conjunction with the attached specification.

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Figure 1 shows a graphical depiction of the various subsystems of a mobile radio station in conjunction with an associated base station within a multiple access environment under the known IMT-2000 standard.

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Figure 2 shows a graphical depiction of the algorithm used by the preferred embodiment to implement the system of the present invention.

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Figure 3 shows a graphical block diagram depiction of the hardware configuration used to implement the method of the preferred environment of the present invention as shown in Figure 2.

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**DETAILED DESCRIPTION OF THE INVENTION**

The following description is provided to enable any person skilled in the art to make and use the invention, and sets forth the best modes presently contemplated by the inventor for carrying out this invention.

- 11 -

1 Various modifications, however, will remain readily apparent to those  
2 skilled in these arts, since the generic principals of the present invention  
3 have been defined herein.

4 The preferred embodiment of the present invention operates within  
5 a rake processing environment. The preferred embodiment determines  
6 when a first packet transmission is not adequately received by a  
7 transmitter. When the system determines that the first packet  
8 transmission is not adequately received, the receiver stores the resulting  
9 failed rake processed signal. An ARQ signal is then sent requiring  
10 retransmission of the signal by the transmitter.

11 The preferred embodiment then performs rake processing upon  
12 the second retransmitted signal. The system combines the previously  
13 stored first, failed, rake-processed transmission result with the  
14 corresponding second, rake processed retransmission result in an  
15 attempt to obtain an adequate signal. If the combined signal is still not  
16 adequate, the combined signal result is again stored, and the process is  
17 reiterated until a resulting signal is adequately obtained.

18 The preferred embodiment of the present invention reiterates the  
19 retransmission process until either (1) the resulting processed signal  
20 results in an adequate transmission being received, or (2) the system  
21 exceeds a default limitation of the number of iterations allowed and the  
22 resulting failed signal is discarded. In the preferred embodiment of the  
23 present invention the maximum number of times, or reiteration threshold,

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1 for allowable retransmission of data packets may be set on a per service  
2 basis. For example, a voice signal communication will have a lower  
3 reiteration threshold than high-speed data since each transmission error  
4 will have less of an affect on the outcome.

5 The preferred embodiment of the present invention determines if  
6 the rake processed received signal is acceptable by testing whether the  
7 processed signal has sufficient power to yield an error free result as an  
8 input for the Viterbi Algorithm. The system of the preferred embodiment  
9 of the present invention recognizes that the metrics of the transmitted  
10 signal take multiple paths across the air interface to the receiver. Due to  
11 this inconsistency in the paths of the multiple metrics of a single signal,  
12 the rake processing of the metrics may result in an unreliable signal being  
13 received. The preferred embodiment recognizes that the power level of  
14 the rake processed signal is a likely determinant of whether the signal is  
15 reliable in relation to the noise incurred across the air interface.

16 The preferred embodiment implements the present invention by  
17 combining transmitted and retransmitted signals based upon the following  
18 equation:

19 
$$M_n(L) = M_n(L-1) + \Delta m_{n,L}$$

20 where: M is the accumulation of the soft decision bit metrics  
21 resulting from the rake processing of the transmissions, L is the number  
22 of the transmission within the multiple corresponding signals being

- 13 -

1 transmitted and retransmitted,  $n$  is the number of the bit within the data  
2 information packet being transmitted,  $D_m$  is the incremental, soft decision  
3 bit reception metric from the  $L$ th, or last, transmission.

4       Figures 2 and 3 show a graphical depiction of the algorithm used  
5 by the preferred embodiment to implement the system of the present  
6 invention. As shown in Figure 2, each transmission TX is comprised of a  
7 series of metrics or fingers M. Each of these metrics M symbolizes a  
8 different one of the multiple path components of the transmission TX  
9 traveling across a different path over the air interface from a transmitter to  
10 a receiver.

11       The reliability of each metric M is determined based upon the path  
12 that it takes across the air interface. As shown in Figure 2, each metric  
13 M is weighted by a value W during rake processing to determine the  
14 potential value and reliability of its contribution to the result of the overall  
15 received signal TX which is to be included within the Viterbi Algorithm. In  
16 the rake processing of the metrics M, the weighted metrics M from a  
17 single transmission are processed and added together by adder 20 to  
18 produce a single resulting outcome 20A which is to be included within the  
19 Viterbi Algorithm.

20       As illustrated by Figure 2, each of the transmissions TX undergoes  
21 identical rake processing by the receiver. The preferred embodiment of  
22 the present invention further adds each of the raked signal outcomes 20A  
23 from each of the rake processed individual signals TX together through

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1 adder 21 in order to obtain a total combined output signal 22. This output  
2 signal 22 is statistically a reliable representation of the transmission TX,  
3 based upon the rake processing of each of signals TX, and their rake  
4 combination together into a single reliable signal 22 which may be  
5 included within the Viterbi Algorithm.

6 Figure 3 shows a further graphical block diagram depiction of the  
7 hardware configuration used to implement the method of the preferred  
8 environment of the present invention as shown in Figure 2. Each of the  
9 metrics M is rake processed with its counterpart metrics M from each  
10 transmission TX.

11 As shown in Figure 3, the output representative 20A of each rake  
12 processed signal 20 is provided along the input 30. The input 30 is then  
13 fed into adder 31. The accumulated output 32 of adder 31 is sent to both  
14 memory 34 where it is stored and processor 33 where it is analyzed for  
15 processing within the Viterbi Algorithm.

16 If processor 33 determines that the processed transmission TX has  
17 been adequately received, then the representative signal of the  
18 transmission is used within the Viterbi Algorithm and sent along output  
19 35 for further processing by the receiver. However, if the processor 33  
20 determines that the output 32 is not an adequately useful signal, i.e., it  
21 does not have sufficient power to be representative of an adequate rake  
22 processed signal, then an output is sent along output line 36, and an  
23 ARQ signal is sent requiring further re-transmission from the transmitter.



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1           The re-transmitted signal is received, rake processed, and the rake  
2   processed representative of the re-transmitted signal is again sent along  
3   input 32 to adder 31. The rake processed signal 30 is added by adder 31  
4   to the previous accumulated rake processed results sent along line 37.

5           By implementing the shown system for recombining ARQ  
6   transmission signals with information obtained from corresponding  
7   previously failed transmissions of the same signal which had been sent  
8   and received across the air interface, the present invention is able to  
9   achieve a reduction in necessary traffic on a multiple access wireless  
10   communications network. The preferred embodiment of the present  
11   invention is further able to address the different transmission and  
12   spectrum needs of multiple services by reducing delay, addressing high  
13   bandwidth needs, reducing transmission errors, reducing interference and  
14   allowing for the gradual degradation of system quality when network  
15   traffic limitations are exceeded.

16          Those skilled in the art will appreciate that various adaptations and  
17   modifications of the just described preferred embodiment can be used  
18   and configured without departing from the scope and spirit of the  
19   invention. Therefore, it is to be understood that, within the scope of the  
20   appended claims, the invention may be practiced other than as  
21   specifically described herein.

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**What is Claimed Is:**

1           1. A multiple access system of communication across a wireless  
2 interface comprising:

3                   a transmitter for transmitting a signal representation of a  
4                   packet of information and retransmitting the signal  
5                   representation of the packet of information;

6                   a receiver for receiving the signal representations of the  
7                   packet of information; and

8                   a means for processing the signal representations of the  
9                   packet of information by combining the transmitted  
10                  signals with the retransmitted signals to obtain an  
11                  output signal representation of the packet of  
12                  information.

1           2. The system of Claim 1 wherein the receiver sends an ARQ  
2 signal to the transmitter when the output signal is deemed to be  
3 unreliable, and the transmitter sends the retransmitted signal in response  
4 to the ARQ signal.

1           3. The system of Claim 1 wherein the receiver sends an ARQ  
2 signal to the transmitter when the output signal is deemed to be  
3 unreliable, and the transmitter sends the retransmitted signal in response

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4 to the ARQ signal, the output signal being deemed to be unreliable when  
5 a default poser limitation is not exceeded.

1 4. The system of Claim 1 wherein the signal representations  
2 received by the receiver have multiple metrics and the processing means  
3 combines the metrics using rake processing.

1 5. The system of Claim 1 wherein the signal representations  
2 received by the receiver have multiple metrics and the processing means  
3 combines the metrics using rake processing to produce a resulting  
4 received representation of the signal representation of the packet of  
5 information.

1 6. The system of Claim 5 wherein the processing means  
2 combines the resulting received representations using rake processing to  
3 produce the output signal representation of the packet of information.

1 7. The system of Claim 6 wherein the processing means  
2 combines the resulting received representations from each successive  
3 retransmission of the signal representation with a previously accumulated  
4 rake processed representation of the signal representation to produce a  
5 new accumulated rake processed representation of the signal  
6 representation, and wherein the new accumulated rake processed  
7 representation is the output signal representation of the packet of  
8 information.

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1           8. The system of Claim 7 wherein the signal representation of the  
2 packet of information is retransmitted by the transmitter until the output  
3 signal representation of the packet of information is deemed reliable.

1           9. The system of Claim 8 wherein the signal representation of the  
2 packet of information is retransmitted by the transmitter an amount of  
3 times until the amount of times exceeds a default limitation of the amount  
4 of times allowed.

1           10. The system of Claim 9 wherein the default limitation is set  
2 based upon whether voice, video or information is being transmitted.

1           11. The system of Claim 1 wherein the transmitted and  
2 retransmitted signals are combined based upon the following equation:

3           
$$M_n(L) = M_n(L-1) + \Delta m_{n,L}$$

4           where: M is an accumulation of soft decision bit metrics resulting  
5 from rake processing of the signals, L is a number of the signal being  
6 retransmitted, n is a number of the bit within the packet of information  
7 being transmitted,  $\Delta m$  is an incremental, soft decision bit reception metric  
8 from a last transmission.

1           12. A multiple access wireless communications system comprising  
2 a transmitter, a receiver, a means for sending ARQ request signals from

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3 the receiver to the transmitter, and a means for combining a retransmitted  
4 signal in response to the ARQ request signal with information from  
5 previously received signals to obtain an output signal.

1 13. A processing system within a multiple access wireless  
2 communications environment, comprising: a receiver receiving signals  
3 transmitted from a transmitter, the signals being retransmitted in response  
4 to an ARQ request signal sent from the receiver to the transmitter, a first  
5 processor to combine metrics from each received signal to produce a first  
6 processor output signal, the first processor output signal being input to an  
7 accumulator, the accumulator receiving the first processor output signal  
8 and a memory output signal and providing an accumulated output to the  
9 memory and a second processor, the second processor testing the  
10 accumulated output and sending the ARQ signal if the accumulated  
11 output does not surpass a poser threshold.

1 14. A method of communication across a wireless interface within  
2 a multiple access system of communication, comprising the steps of:  
3 transmitting a signal representation of a packet of  
4 information;  
5 retransmitting the signal representation of the packet of  
6 information;  
7 receiving the signal representations of the packet of  
8 information; and

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9 combining the transmitted signals with the retransmitted  
10 signals to obtain an output signal representation of  
11 the packet of information.

1 15. The system of Claim 14 including the further step of sending  
2 an ARQ signal from the receiver to the transmitter when the output signal  
3 is deemed to be unreliable, and sending the retransmitted signal in  
4 response to the ARQ signal.

1 16. The system of Claim 14 including the further step of  
2 determining when the output signal is not reliable when a default power  
3 limitation is not exceeded, the receiver sending an ARQ signal to the  
4 transmitter when the output signal is deemed to be unreliable, and the  
5 transmitter sending the retransmitted signal in response to the ARQ  
6 signal.

1 17. The system of Claim 14 wherein the signal representations  
2 received by the receiver have multiple metrics and including the step of  
3 combining the metrics using rake processing to produce a resulting  
4 received representation of the signal representation of the packet of  
5 information.

1 18. The system of Claim 17 further including the step of combining  
2 the resulting received representations using rake processing to produce  
3 the output signal representation of the packet of information.

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1           19. The system of Claim 18 further including the step of combining  
2 the resulting received representations from each successive  
3 retransmission of the signal representation with a previously accumulated  
4 rake processed representation of the signal representation to produce a  
5 new accumulated rake processed representation of the signal  
6 representation, and wherein the new accumulated rake processed  
7 representation is the output signal representation of the packet of  
8 information.

1           20. The system of Claim 19 wherein the signal representation of  
2 the packet of information is retransmitted by the transmitter until the  
3 output signal representation of the packet of information is deemed  
4 reliable.

1           21. The system of Claim 19 wherein the signal representation of  
2 the packet of information is retransmitted by the transmitter an amount of  
3 times until the amount of times exceeds a default limitation of the amount  
4 of times allowed.

1           22. The system of Claim 21 further including a step of determining  
2 the default limitation based upon whether voice, video or information is  
3 being transmitted.

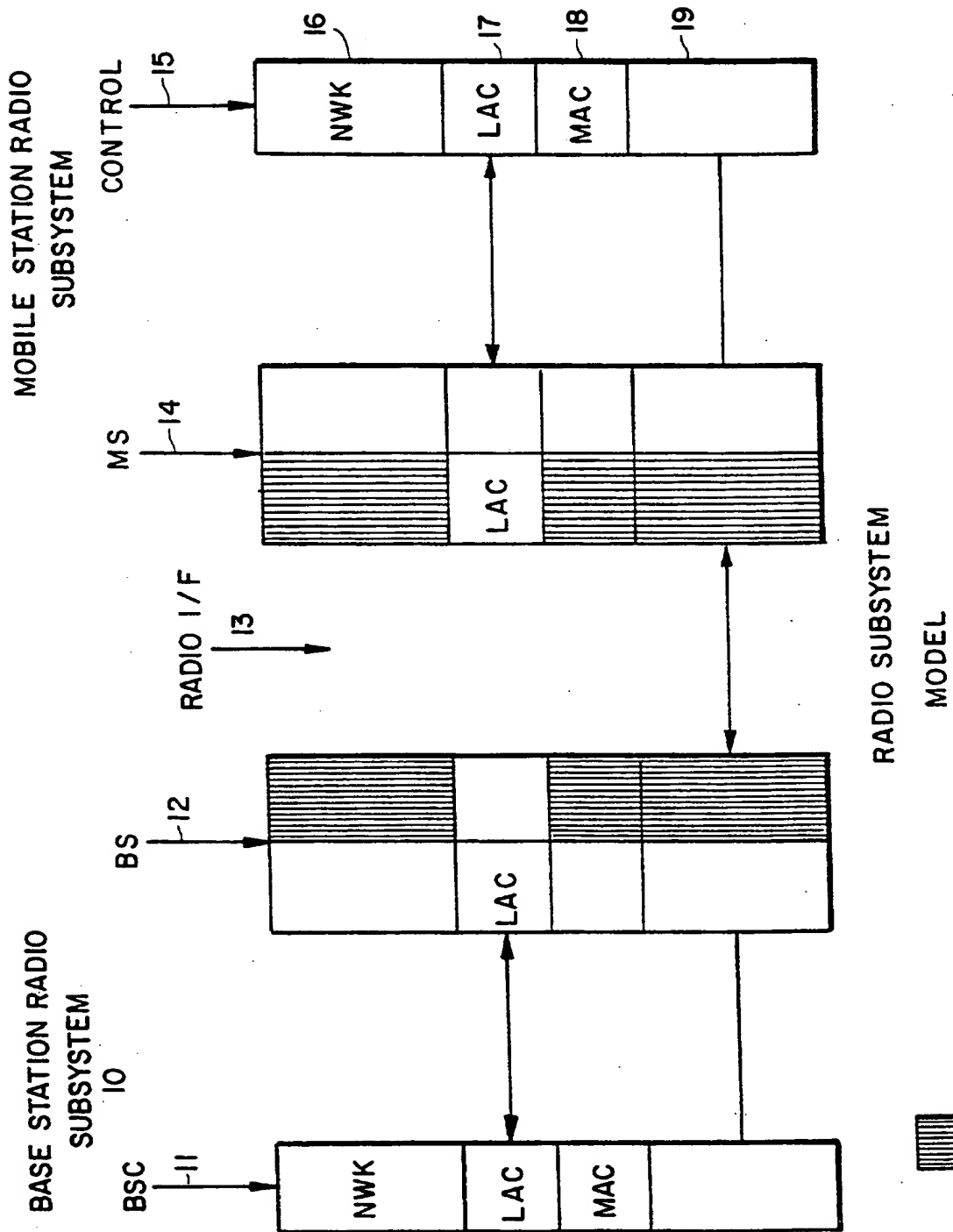
- 22 -

1           23. The system of Claim 14 wherein the transmitted and  
2 retransmitted signals are combined based upon the following equation:

3           
$$M_n(L) = M_n(L-1) + \Delta m_{n,L}$$

4           where: M is an accumulation of soft decision bit metrics resulting  
5 from rake processing of the signals, L is a number of the signal being  
6 retransmitted, n is a number of the bit within the packet of information  
7 being transmitted,  $\Delta m$  is an incremental, soft decision bit reception metric  
8 from a last transmission.





**FIG. 1**

**DENOTES RADIO  
DEPENDENT**

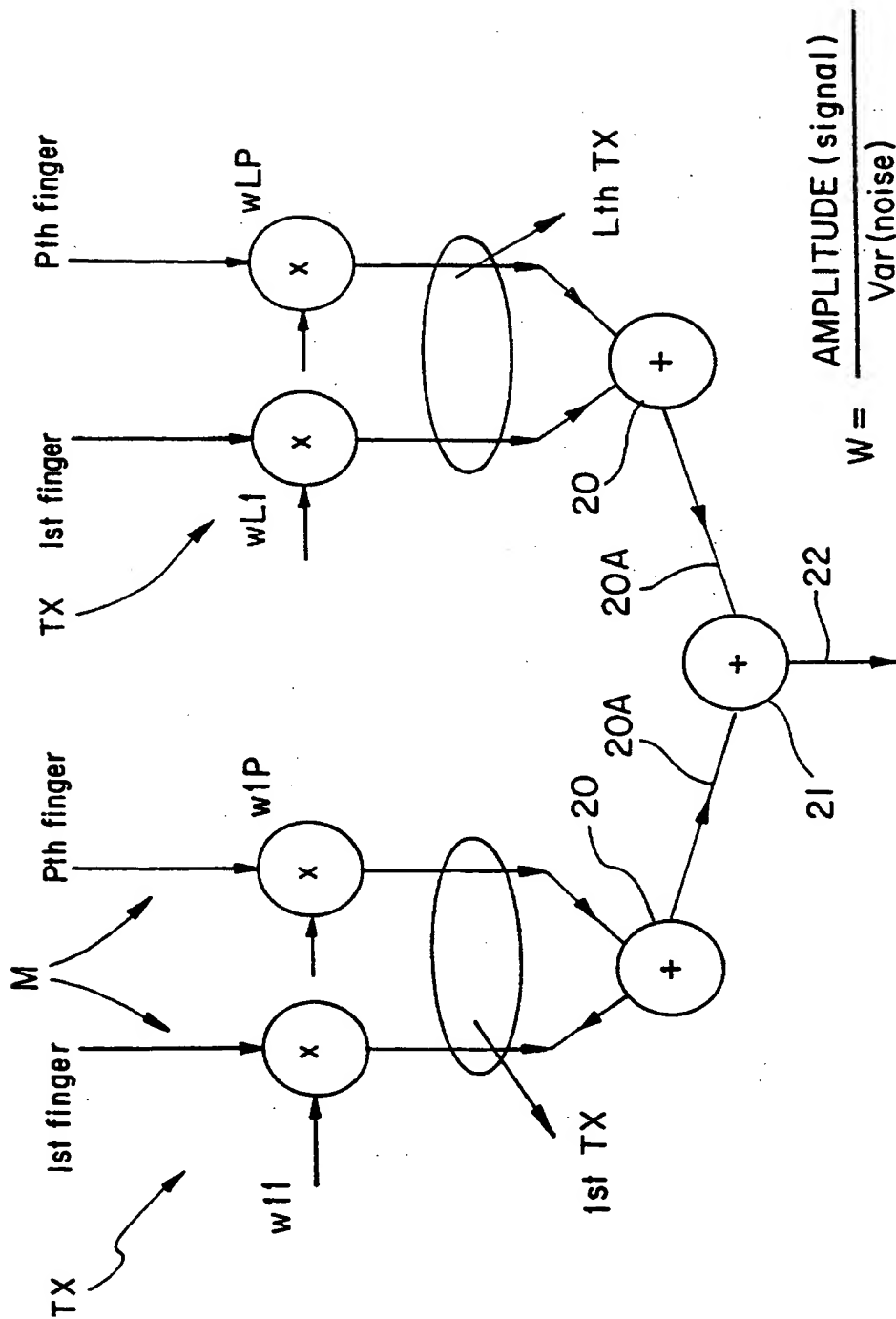


FIG. 2

3 / 3

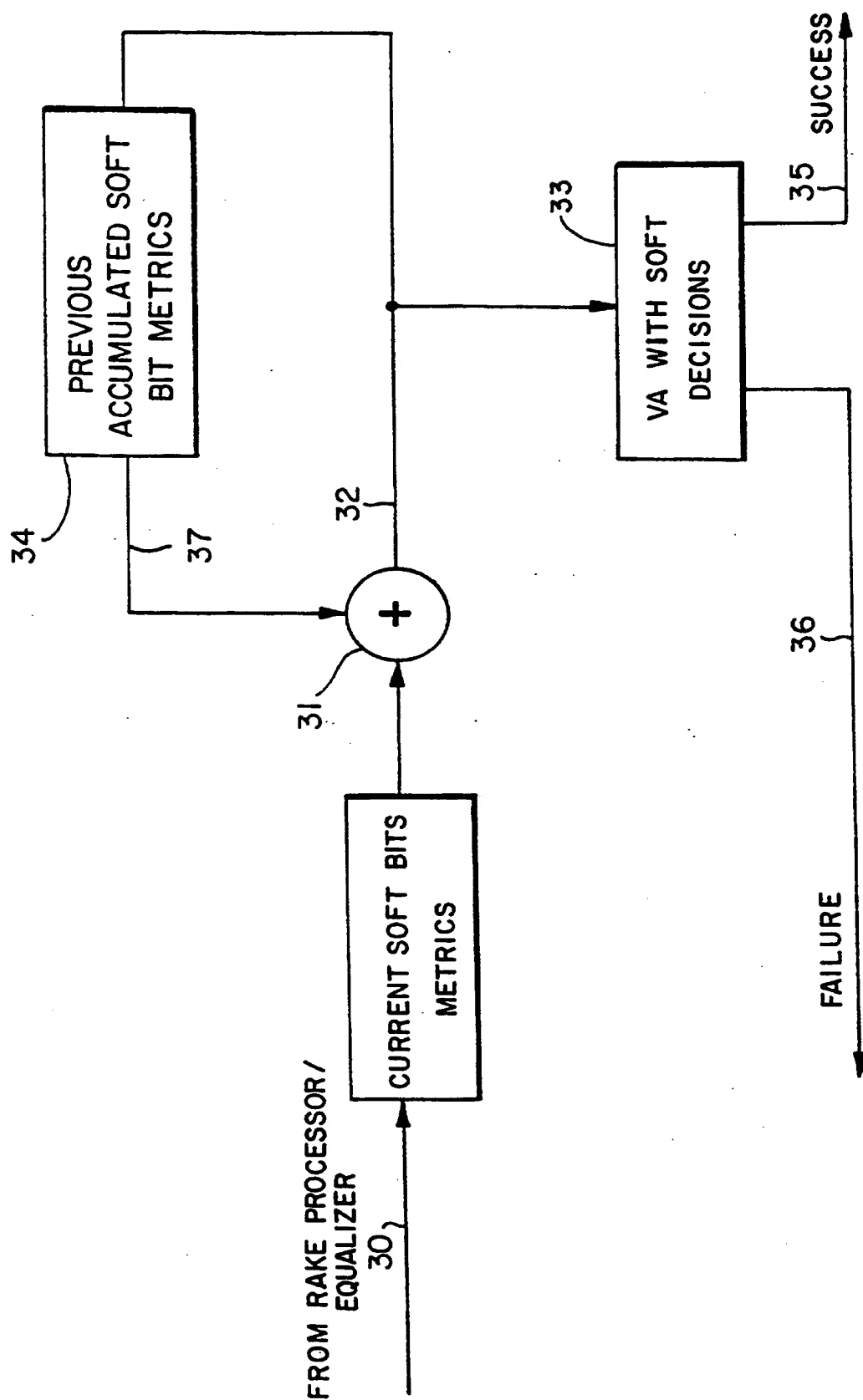


FIG. 3

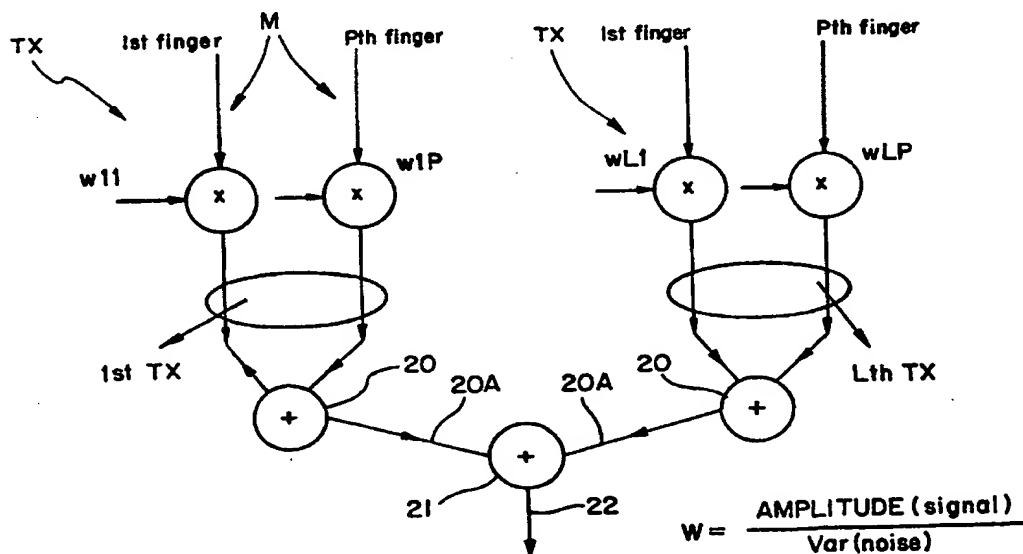




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## (54) Title: RETRANSMISSION OF DATA PACKETS IN A WIRELESS MULTIMEDIA COMMUNICATIONS SYSTEM



## (57) Abstract

A "hybrid" ARQ system within a multiple access wireless communications environment is provided for recombining ARQ retransmission signals with information obtained from corresponding previously failed transmissions of the same signal which had been sent and received within the air interface. Forward Error Correction (FEC) is implemented within an ARQ environment by using whatever acquired information has been previously obtained from RAKE processed transmitted and retransmitted signals and trying to correct the information by combining the signals and without retransmission.

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# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/US 98/18446

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 H04L1/18

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>BAKHTIYARI S ET AL: "PRACTICAL IMPLEMENTATION OF A MOBILE DATA LINK PROTOCOL WITH A TYPE II HYBRID ARQ SCHEME AND CODE COMBINING" PERSONAL COMMUNICATION - FREEDOM THROUGH WIRELESS TECHNOLOGY, SECAUCUS, NJ., MAY 18 - 20, 1993, no. CONF. 43, 18 May 1993, pages 774-777, XP000393297 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see page 774, left-hand column, line 14 - line 27 see page 775, left-hand column, line 17 - line 33</p> <p style="text-align: center;">---</p> <p style="text-align: center;">-/--</p>	1-3, 13-15

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
X	<p>KALLEL S ET AL: "SEQUENTIAL DECODING WITH AN EFFICIENT PARTIAL RETRANSMISSION ARQ STRATEGY"</p> <p>IEEE TRANSACTIONS ON COMMUNICATIONS, vol. 39, no. 2, 1 February 1991, pages 208-213, XP000225303</p> <p>see page 208, left-hand column, line 1 - page 209, left-hand column, line 10</p> <p style="text-align: center;">---</p>	<p>1-3, 13-15</p>
A	<p>M.J.MCTIFFIN, A.P. HULBERT, T.J. KETSEOGLOU, ET AL.: "Mobile Access to an ATM Network Using a CDMA Air Interface"</p> <p>IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, vol. 12, no. 5, June 1994, pages 900-908, XP002096626</p> <p>see abstract</p> <p>see page 905, right-hand column, line 10 - page 907, left-hand column, line 5</p> <p style="text-align: center;">-----</p>	<p>1-23</p>